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$$y = \pm \frac{b^{\frac{2}{3}}}{\sqrt[3]{a^{\frac{2}{3}} + b^{\frac{2}{3}}}}, = \pm \left(\frac{20\sqrt[3]{2}}{1 + \sqrt[3]{2}} \right)^{\frac{1}{2}}.$$

V. Solution by CHAS. A. HOBBS, A. M., Master of Mathematics in the Belmont School, Belmont, Massachusetts.

$$x^2 + x^{\frac{1}{2}} y^{\frac{1}{2}} = 10, \quad y^2 + x^{\frac{1}{2}} y^{\frac{3}{2}} = 20. \quad \text{Let } y = vx.$$

$$\text{Then } x^2 + v^{\frac{1}{2}} x^2 = 10, \quad v^2 x^2 + v^{\frac{3}{2}} x^2 = 20.$$

$$\therefore x^2 = \frac{10}{1 + v^{\frac{1}{2}}}, \text{ and } x^2 = \frac{20}{v^2 + v^{\frac{3}{2}}}. \quad \therefore \frac{10}{1 + v^{\frac{1}{2}}} = \frac{20}{v^2 + v^{\frac{3}{2}}}.$$

Dividing by 10, and clearing of fractions, $v^{\frac{1}{2}} = 2, v = 2^{\frac{4}{3}}.$

$$\therefore x^2 = \frac{10}{1 + 2^{\frac{1}{2}}}, \quad x = \sqrt{\frac{10}{1 + \sqrt[3]{2}}}. \quad y = 2^{\frac{1}{3}} \sqrt{\frac{10}{1 + \sqrt[3]{2}}} = \sqrt{\frac{20\sqrt[3]{2}}{1 + \sqrt[3]{2}}}.$$

VI. Solution by J. W. WATSON, Middle Creek, Ohio; and H. C. WILKES, Skull Run, West Virginia.

Put $x = m^2, y = n^2$. Then, the given equations become, after factoring,

$$m^3(m+n) = 10 \dots\dots\dots(1), \text{ and } n^3(m+n) = 20 \dots\dots\dots(2). \quad \text{Whence } n = m\sqrt[3]{2}.$$

$$\text{Then in (1) } m^3(m + m\sqrt[3]{2}) = 10, \text{ or } m^4(1 + \sqrt[3]{2}) = 10.$$

$$\therefore m^4 = \frac{10}{1 + \sqrt[3]{2}}, \text{ and } m^2 = \pm \sqrt{\frac{10}{1 + \sqrt[3]{2}}}, = x.$$

$$\text{Also, } n^2, = y, = \pm \sqrt{\frac{20\sqrt[3]{2}}{1 + \sqrt[3]{2}}}.$$

GEOMETRY.

Conducted by B. F. FINKEL, Springfield, Mo. All contributions to this department should be sent to him.

SOLUTIONS OF PROBLEMS.

56. Proposed by WILLIAM HOOVER, A. M., Ph. D., Professor of Mathematics and Astronomy, Ohio University, Athens, Ohio.

The locus of the centers of the isogonal transformations of all the diameters of the circumcircle of any triangle is the nine-points circle. *Brocard.*

I. Solution by G. B. M. ZERR, A. M., Ph. D., Professor of Mathematics and Applied Science in Texarkana College, Texarkana, Arkansas-Texas.

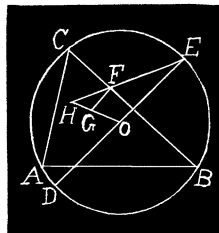
Let O and H be the circum and ortho-centers respectively of the triangle ABC . Draw the diameter DE , connect E and H , and from F the mid-point of EH draw FG parallel to OE .

Now H and O are inverse points.

G is the mid-point of HO and $GF = \frac{1}{2}OE = \text{a constant}$.

$\therefore G$ is the center and GF the radius of the nine-point circle.

\therefore The locus of F is the nine-point circle.



II. Solution by the PROPOSER.

Let $l\alpha + m\beta + n\gamma = 0 \dots \dots \dots (1)$ be any diameter. The isogonal transformation of (1) is

$$\frac{l}{\alpha} + \frac{m}{\beta} + \frac{n}{\gamma} = 0 \dots \dots \dots (2).$$

Now (1), passing through the center of the circumcircle, the coordinates of which are proportional to $\cos A$, $\cos B$, $\cos C$, gives the relation

$$l\cos A + m\cos B + n\cos C = 0 \dots \dots \dots (3).$$

Also, the center of (2), which is an equilateral hyperbola, with condition (3), is given by

$$\frac{l}{n} = \frac{-a\alpha^2 + b\alpha\beta + c\alpha\gamma}{b\beta\gamma - c\gamma^2 + a\alpha\gamma}, \quad \frac{m}{n} = \frac{a\alpha\beta - b\beta^2 + c\beta\gamma}{b\beta\gamma - c\gamma^2 + a\alpha\gamma} \dots \dots \dots (4).$$

Dividing (3) by n , and substituting equations (4), and reducing,

$$a\beta\gamma + b\alpha\gamma + c\alpha\beta - a\alpha^2\cos A - b\beta^2\cos B - c\gamma^2\cos C = 0 \dots \dots \dots (5),$$

the nine-points circle.

57. Proposed by J. OWEN MAHONEY, B. E., Graduate Fellow and Assistant in Mathematics, Vanderbilt University, Nashville, Tennessee.

Show that pairs of points, on a straight line, may be so related harmonically that a pair of real points will be harmonic with regard to a pair of imaginary points, and by this means prove that there are an indefinite number of conjugate pairs of imaginary points on a real line.

I. Solution by WILLIAM HOOVER, A. M., Ph. D., Professor of Mathematics and Astronomy in Ohio University, Athens, Ohio.

If the four points be A , B , C , D , and the axis of x coincide with the given straight line, A , B may be supposed given by